



## AMS Tracker Thermal Control Subsystem QM/FM Condenser Manifold Brazing Procedure

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Sun Yat-Sen University (SYSU)  
National Aerospace Laboratory (NLR)  
Istituto Nazionale di Fisica Nucleare (INFN)  
Aerospace Industrial Development Corporation (AIDC)

	NAME	ORGANISATION/RESPONSIBILITY	SIGNATURE	DATE
PREPARED	E. Laudi	INFN		
CHECKED	J. van Es	NLR / AMS SE		26/06/2008
AGREED	A. Pauw	NLR / AMS PA		20080623
APPROVED	J. van Es	NLR / AMS PM		26/06/2008
AUTHORISED	P. Dieleman	NLR Space Department		26/06/2008

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### Document change log

<u>Change Ref.</u>	<u>Section(s)</u>	<u>Change</u>
Initial issue	All	Initial issue
		Update from RD-3 New pictures and drawings according to the new design of manifolds and condenser Added general info on brazing and transport jig and brazing plates Added stop off agent steps fro brazing plates Change of the temperature profile according to EM brazing Removal of the manifold bracket before the brazing Update of procedure numbers
Draft 3	All	Draft 3
<u>Issue 1</u>	1.0	Updated manufacturing sequence
	4.1	Updated temperature profile
	4.2	Binder and brazing material specification added
		Nickel plating step added in the procedure sheet ( step 9, 10 and 11)
		Spot welding position updated(step 17)
		Brazing material position detail (step 18)



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## Summary

This document describes the QM/FM Condenser manifold brazing procedure. The brazing procedure is part of the QM/FM condenser manufacturing sequence as described in the Condenser design document.



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(20 pages in total)



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## 1 Scope of the document

The procedure in this document describes the brazing procedure of the QM/FM condenser manifold.

The procedure can be used to braze:

- QM condenser manifold Test sample
- QM/FM condenser manifolds
  - including a reference manifold sample following the same sequence

The procedure defines the temperature profile and the sequence of steps.

### Overall Condenser Manufacturing sequence

(For the most update version of the sequence see RD-1)

1. Bend individual tubes
2. Label tube
3. He leak test for individual tubes AMSTR-NLR-PR-040 ( to be finalized)
4. Cut tubes to exact length according to the cutting procedure AMSTR-NLR-PR-008-v.2. QM/FM Condenser Manifold Brazing Procedure (to be approved)
  - a. Avoid chips entering the tubes during cutting
5. Clean tubes inside & outside and seal the end: AMSTR\_NLR-039 (to be approved)
6. Manufacture brazing plates
7. **Apply stop off agent on brazing component** AMSTR-NLR-041 (to be added in the brazing procedure)
8. Manufacture bottom, top plates and strain relieves in AL 2024 T351
9. Convert to AL 2024 T851 (worksheet by AIDC)
10. Manufacture manifold parts and filters
11. Clean manifold parts and filter AMSTR-NLR-039
12. **Perform nickel plating on tubes side to be brazed** according to **AMS 2403L**
13. **Spot weld condenser tubes to manifold and apply solder around tubes**
14. **Braze tubes and manifolds** AMSTR\_NLR-041
15. He leak test on condenser tubing lay-out AMSTR-NLR -040
16. Proof pressure test up to 1.5 MDP =  $1.5 * 160 = 240$  bar AMSTR-NLR -040
17. He leak on condenser tubing lay-out AMSTR-NLR -PR 040
18. Install nutplates on top plate
19. Surface treatment of condenser plates and tube before gluing AMSTR-NLR-PR-38



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20. Glue the condenser tubes to the base plate AMSTR-NLR-PR-38
21. Glue the top plate to the bottom plate and glue strain reliefs; AMSTR-NLR-PR-38
22. Glue foil heaters on top plate; AMSTR-NLR-PR-38
23. Clean outside tubes, manifold and condenser plates according to : AMSTR-NLR-PR.039
24. Apply wire heater according to AMSTR-NLR-PR-043
25. Do a mass check/measurement on the condenser and condenser bolts
26. Fix condenser with bolts to transport jig AMSTR-AIDC-PR-023
27. Perform an outgoing inspection (visual and electrical) according to AMSTR-NLR-PR-47
28. Perform thermal cycling test according TTCS-SYSU-TEMP-001: only for QM
29. Apply TS according to AMSTR-NLR-PR-49 ( to be written) only for FM
30. Integrate the condenser to radiator according to AMSTR-NLR-PR-48

In this overall sequence no mention of the brazing test samples is done.

## **2 References documents**

	Title	Number	Date
RD-1	TTCS Leak rate	AMSTR-NLR-TN-046-Issue 1.0	April 2006
RD-2	TTCS Condenser Design Document	AMSTR-NLR-TN-045-Issue 1.1	
RD-3	QM/FM Condenser Manifold Brazing Procedure	AMSTR-NLR-PR-041-Issue 3.0	June 2007



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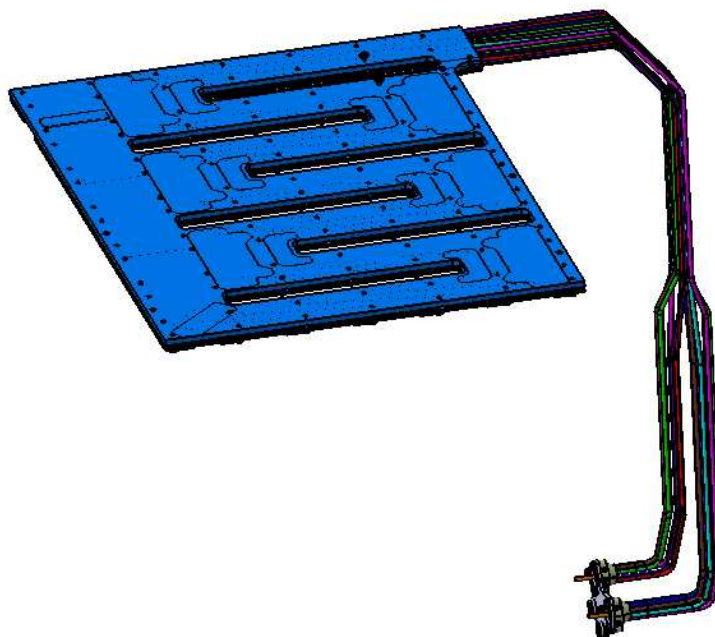
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### 3 Manifold and condenser assembly description

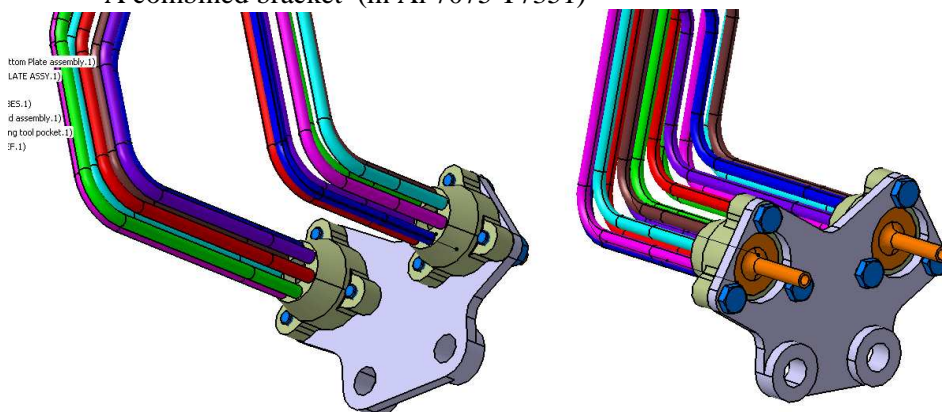
The manifold is part of the TTCS condenser as shown in Figure 3-1.



**Figure 3-1: TTCS Condenser**

The manifold assembly is shown Figure 3-2. The condenser assembly consist of

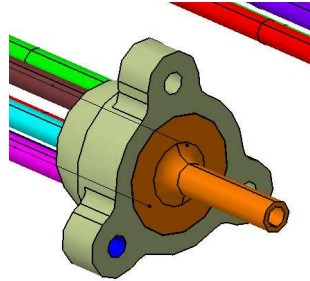
- 7 capillary tubes (in Inconel 718)
- Two Manifold pieces (in SS316L)
  - Each manifold contains a filter not shown in the design
- A combined bracket (in Al 7075 T7351)



**Figure 3-2: TTCS Condenser Manifold Assembly**



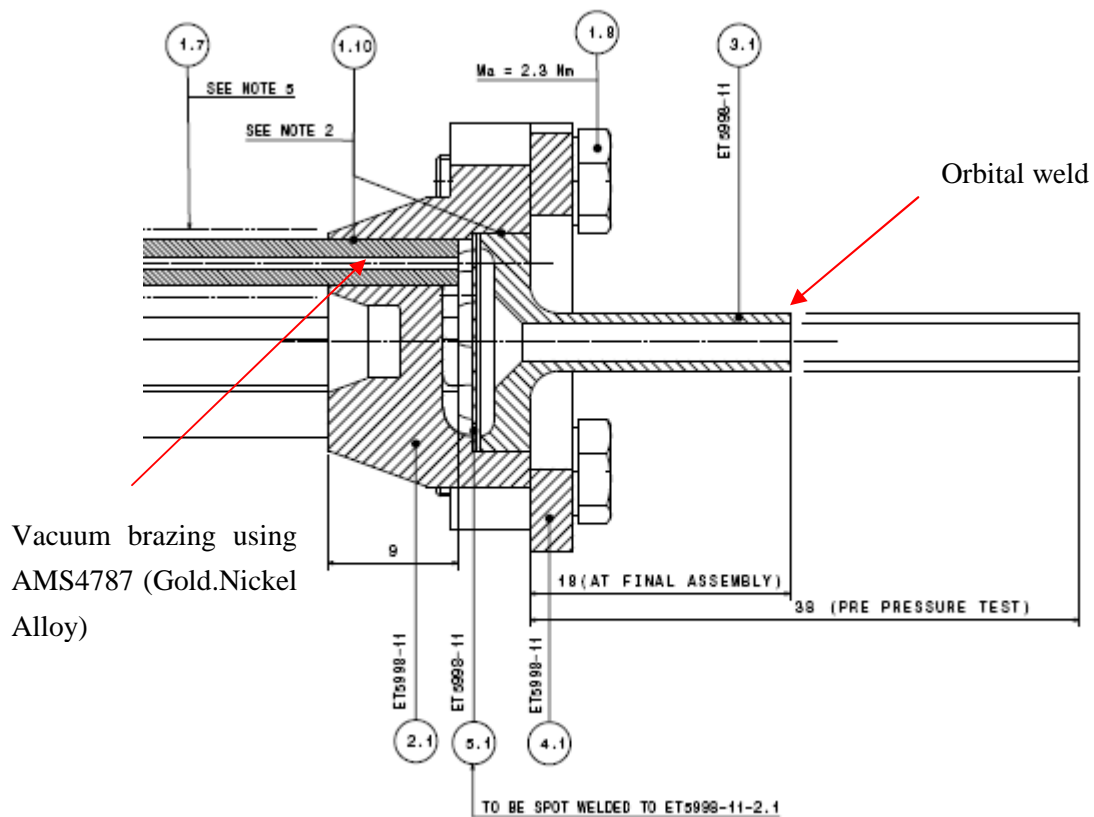
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**Figure 3-3: QM manifold brazing Test assembly**

The brazing sample test will consist of:

1. Small capillary Inconel 718 tubes (AMS 5589 D)
2. Condenser manifold parts
3. Filter
4. Brazing material AMS4787 (Gold-Nickel Alloy)



**Figure 3-4: Manifold drawing (from Assembly drawing of condenser: no bolts will be used during the brazing and length of manifold connector (right) is 51.5 mm)**



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### 4 Brazing procedure

During the brazing process the condenser brazing and transport jig (made of SS304) will support the tubes through stainless steel 304 brazing plates (Figure 4-1).

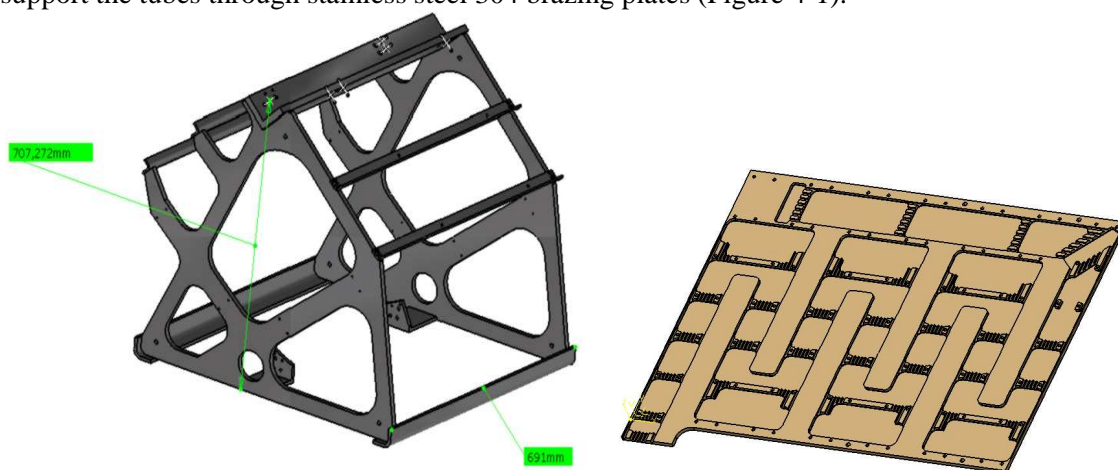


Figure 4-1. Transport and brazing jig (left) and brazing bottom plate.

Owing to the tube material (Inconel 718 is available in AMS 5589D) the brazing of the manifold will be followed by a hardening process. To finally come to the required strength the following steps will be performed:

1. Apply stop off agent on brazing plate and bolts
2. nickel plating of tube (only on manifold side)
3. Brazing of manifold and tubes
4. Return to ambient
5. Hardening of Inconel 718 according to AMS 5589 D

The two separate temperature profiles are shown in Figure 4-1 and Figure 4-2. In figure 4-1 the AIDC temperature profile for the EM brazing manifold is described. Also for QM and FM will be used the same. In figure 4-2 the hardening process is described.

In section 4.2 the brazing steps are given. For reference a sample manifold will follow the same complete sequence to have the ability to check the brazing process. It also includes He-leak tests in between steps when necessary.



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## 4.1 Brazing temperature profile

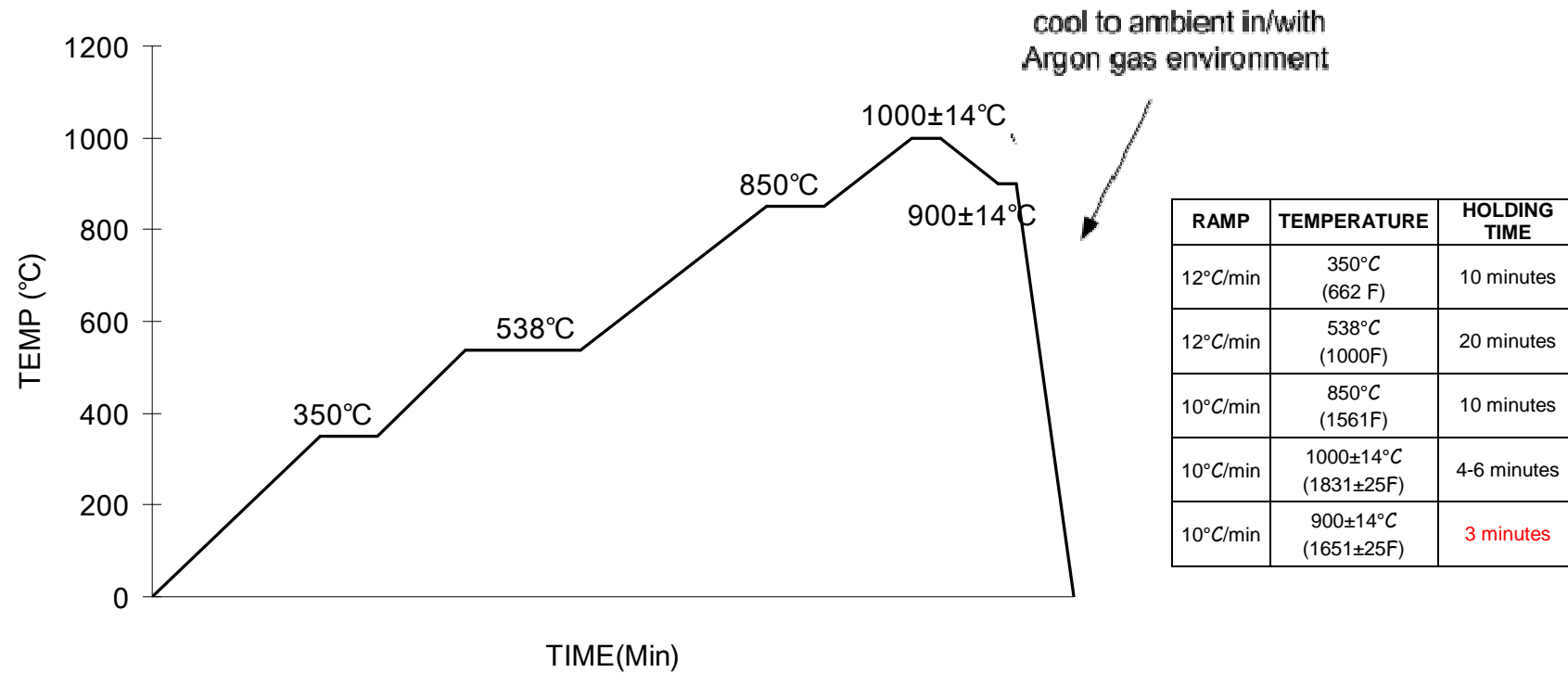


Figure 4-1: Brazing Temperature profile



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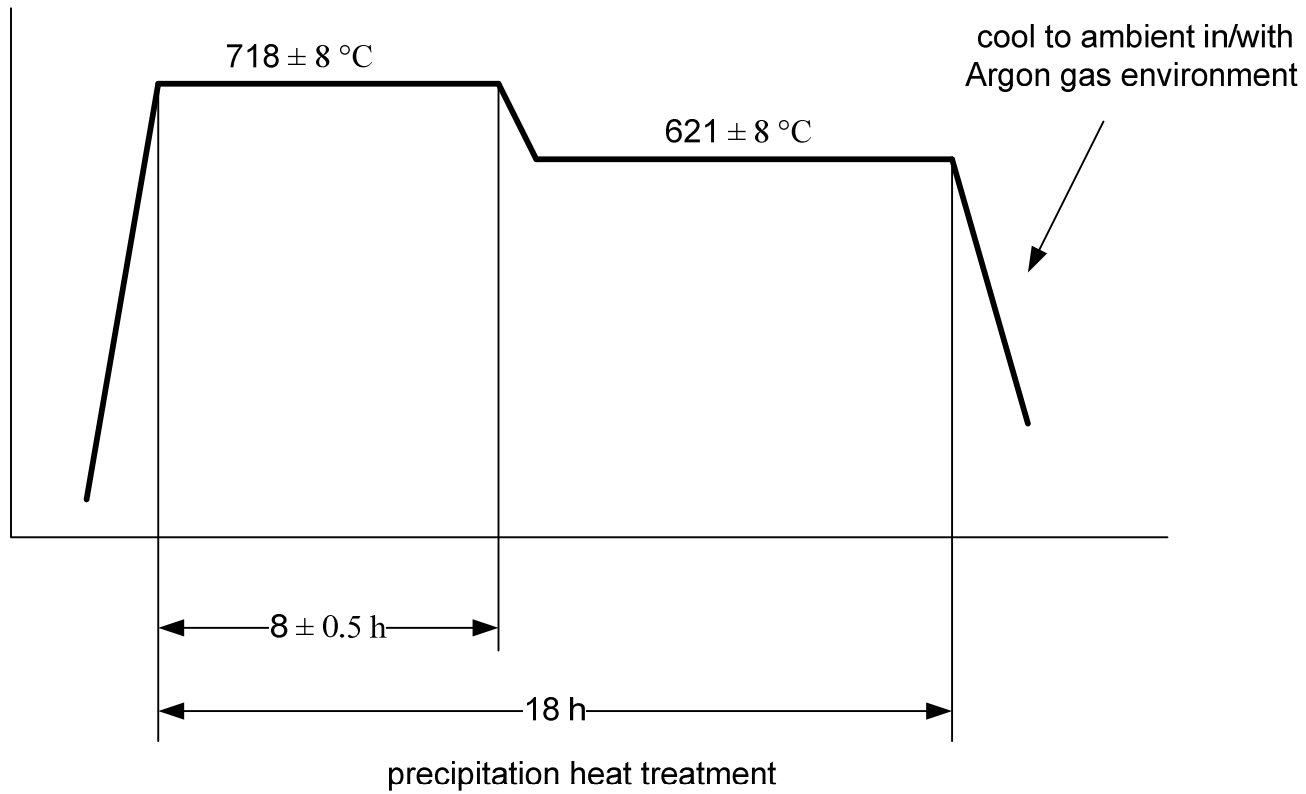


Figure 4-2: Temperature profile for strain hardening according to AMS 5589D

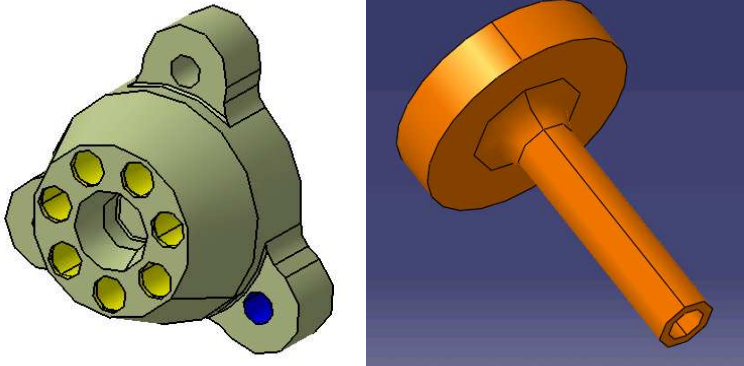


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### 4.2 Manifold Integration and Brazing procedure in steps


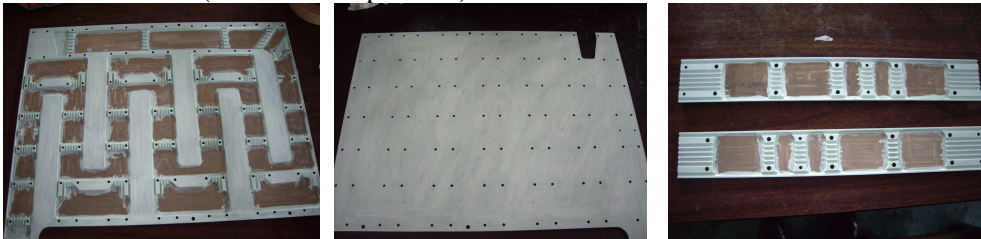
Test sample indication:		Test engineer:	Test Date:
Step	Action to be taken	Result	
1.	Condenser manifold test sample number /Condenser QM or FM		
	<b>Record material specification</b>		
2.	Material part 2.1 & Material part 3.1 (note final used drawing numbers here) 		
3.	Filter material		
4.	Capillary condenser tube material		
5.	Brazing plate material (N.A for test sample)		
6.	Record stop off agent material used (N.A for test sample)		
7.	Check brazing and binder material (requirement: AMS4787 powder(85~90%) will be combined with		



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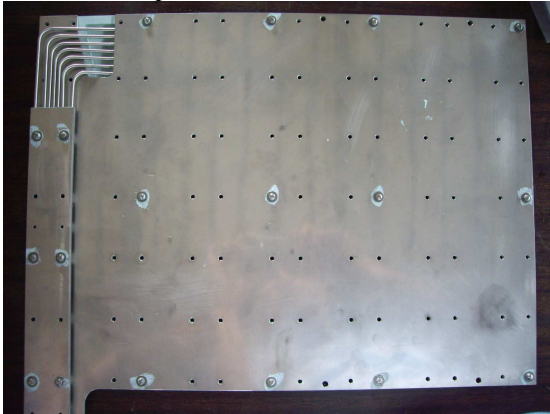
	binder(10~15%)(Wall Colmonoy Microbraz cement510) and Acetone(as require)	
8.	Record vacuum oven used (type and serial number)	
9.	Use a tape to cover the tubes part that will not experience the nickel plating process. Record the tape type. 	
10.	Close the entrance of the tube to avoid the nickel plating flow inside the tubes (use something like a wire)	
11.	Perform nickel plating on tubes area that will be in contact with brazing material ( i.e. manifold side) according to AMS 2403L	
	<b>Apply stop-off agent</b> (N.A for test sample)	
12.	Apply stop off agent on bottom&top brazing plates and bottom&top brazing strain relieves in the contact areas with tubes (as in the EM pictures) 	
13.	Apply stop off agent on brazing fasteners	



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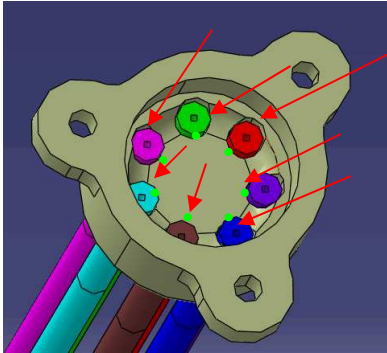

14.	Install brazing plates(bottom, top and strain relieves) on brazing and transport jig using brazing bolts as in the EM set-up 	
	<b>Brazing preparations and manifold filter integration</b>	
15.	Clean Manifold parts according to AMSTR-NLR-PR-039 QM/FM Condenser Cleaning Procedure	
16.	Use clean gloves when handling the clean manifolds during spot welding	
17.	Spot weld 7 (condenser or sample) tubes to part 2.1 .Use Argon Tig Welding without weld material. Leave 1 mm length of tube inside part 2.1. Spot Weld as far away as possible from the brazing area to avoid oxidation problem. Write down spot welding equipment and main parameters.	



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18.	<p>Put brazing material at brazing positions. Apply brazing material into the edge between tube &amp; part 2.1(RED arrow).No necessary to cover the central area with the brazing material.</p> <div>   </div>	
19.	Remove manifold bracket from the transport& brazing Jig (N.A for test sample)	
20.	Put filter into part 2.1	

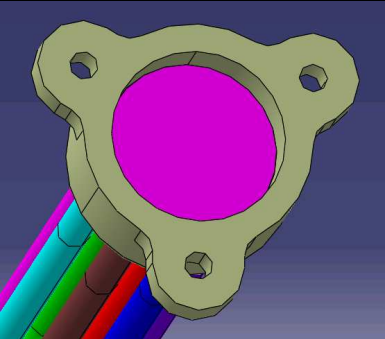
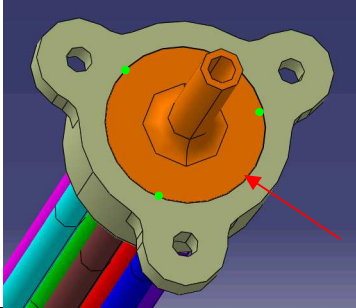




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21.	Make digital pictures of the filter set-up and store it digitally	
22.	IT IS NOT ALLOWED TO USE STOP-OFF AGENT on manifold area	
23.	Fix part 3.1 into part 2.1 Using argon welding without weld material (see green points) 	
24.	Apply solder material into edge between part 2.1 and part 3.1	



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	<b>Perform temperature cycle as indicated in Figure 4-1 and Figure 4-2 with oven</b>	
25.	Put set-up in vacuum oven <b>together with reference sample</b>	
26.	Apply vacuum to oven	
27.	Perform temperature profile as indicated in Figure 4-1. Pay attention: Last slope of Figure 4-1 is applied by cooling with Argon to ambient temperature	
28.	Inspect visually the brazing product	
29.	Make picture from the brazing product (note picture file name)	
30.	Apply vacuum to oven	
31.	Perform temperature profile as indicated in Figure 4-2 .	
32.	Inspect visually the brazing product	
33.	Make picture from the brazing product (note picture file name)	
34.	ONLY FOR TEST SAMPLE: Close/seal the 7 tube ends hermetically to withstand (240 bar).Seal the end of 7 small tube using Argon welding(TIG) with weld material CRES347(MSRR9500/207) .030"Dia. FOR TEST AND QM/FM: close end of manifold with plastic bag	
35.	Transport to AIDC Taichung facility	



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36.	Perform Helium leak test according to : AMSTR-NLR-PR-002 ISSUE 2.0 MAY 2007 : for TEST SAMPLES AMSTR-NLR-PR-040: for QM & FM condenser assembly Remark: Swagelok couplings for leak testing	
37.	Perform Proof Pressure test to test sample up to 240 bar with N2 according to: Addendum to AMSTR-NLR-PR-002 ISSUE 2.0 MAY 2007 : for TEST SAMPLES AMSTR-NLR-PR-040- : for QM & FM condenser assembly	
38.	Inspect visually the brazing product	
39.	Make picture from the brazing product (note picture file name)	
40.	Perform Helium leak test according to : AMSTR-NLR-PR-002 ISSUE 2.0 MAY 2007 : for TEST SAMPLES AMSTR-NLR-PR-040- : for QM & FM condenser assembly	
41.	ONLY FOR TEST SAMPLE: Perform Brazing check according to <b>AMSTR-NLR-PR-005 ISSUE 2.0 December 2007</b>	
42.	<b>General remarks and notes</b>	



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